KERN & Sohn GmbH
Ziegelei 1
D-72336 Balingen
E-Mail: info@kern-sohn.com
Phone: +49-[0]7433- 9933-0
Fax: +49-[0]7433-9933-149
Internet: www.kern-sohn.com

Operating instructions
Density Scale

KERN EMB-V

Version 2.0
01/2013
GB

EMB-V-BA-e-1320

GB

KERN EMB-V

Version 2.0 01/2013

Operating instructions

Density Scale

English

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English

1 Technical data

KERN	EMB 200-3V	EMB 2000-2V
Readability (d)	0.001 g	0.01
Weighing range (max)	200 g	2000 g
Reproducibility	0.002 g	0.02
Linearity	± 0.003 g	± 0.03 g
Recommended adjustment weight, not added (class)	200 g (F1)	2000 g (F1)
Stabilization time (typical)	2.5 sec	
Warm-up time	2 h	
Unit	g	
Operating temperature	+5°C… +35°C	
Humidity of air	max. 80 % (not condensing)	
Housing (B x D x H) mm	170 x 240 x 39	
Weighing plate mm	Ø 82	Ø 150
Battery operation (optional)	9V block Operating time: 12 h	
Mains adapter	100 mA / 9V	
AUTO-OFF-function (With battery operation)	3 min.	
Underfloor weighing	Standard hooks	
Interface	RS-232 standard	

2 Appliance overview

KERN EMB 200-3V

KERN EMB 2000-2V

bottom side

❶ Weighing pan
❷ Display
❸ Keyboard
❹ RS 232
❺ Battery compartment
❻ Underfloor weighing

English

2.1 KERN EMB 200-3V with installed density kit KERN YDB-01

❶ Upper sample dish of the immersion basket

❷ Weighing plate "density kit"

❸ Beaker

❹ Lower sample dish of the immersion basket

❺ Platform

2.2 KERN EMB 2000-2V with installed density kit KERN YDB-02

❶ Upper sample dish of the immersion basket

❷ Beaker

❸ Lower sample dish of the immersion basket

❹ Platform

❺ Weighing plate "density kit"

2.3 Keyboard overview

Key	Function
	• Turn on/off
	• Calculate weighing data via interface • Menu access (longer pressing of the button)
	• Cancel process/input • Density determination mode to switch over to weighing mode
	• Numeric input / dialing digits to the right
	• Taring / Setting to zero • Confirm • Save and exit menu • Adjustment menu access (longer pressing of the button)
	• Density determination access mode for solids • Scroll backwards in menu
	• Density determination access mode for liquids • Scroll forward in menu
	• Weighing in air
	• Weighing in liquid

2.3.1 Numeric entry

Key	Function
	Dialing the digits to the right, each active site flashes.
	Each time you press the button, the numerical value of the flashing digit increases.
	Confirm entry

3 Basic Information (General)

3.1 Proper use

The scale purchased by you is intended to determine the density of solids and liquids. The determination of the density is based on the Archimedean Principle, see chapter 8.1.

Furthermore, the scale can also be used to determine the weighing value of the weighing object. It is intended to be used as a “non-automatic balance”, i.e. the material to be weighed is manually and carefully placed in the centre of the weighing pan. As soon as a stable weighing value is reached the weighing value can be read.

3.2 Improper Use

- Do not use balance for dynamic add-on weighing procedures, if small amounts of goods to be weighed are removed or added. The “stability compensation“ installed in the balance may result in displaying an incorrect measuring value! (Example: Slowly draining fluids from a container on the balance.)
- Do not leave permanent load on the weighing pan. This may damage the measuring system.
- Impacts and overloading exceeding the stated maximum load (max) of the balance, minus a possibly existing tare load, must be strictly avoided. Balance may be damage by this.
- Never operate balance in explosive environment. The serial version is not explosion protected.
- The structure of the balance may not be modified. This may lead to incorrect weighing results, safety-related faults and destruction of the balance.
- The balance may only be used according to the described conditions. Other areas of use must be released by KERN in writing.

3.3 Warranty

Warranty claims shall be voided in case

- Our conditions in the operation manual are ignored
- The appliance is used outside the described uses
- The appliance is modified or opened
- Mechanical damage or damage by media, liquids, natural wear and tear
- The appliance is improperly set up or incorrectly electrically connected
- The measuring system is overloaded

3.4 Monitoring of Test Resources

In the framework of quality assurance the measuring-related properties of the balance and, if applicable, the testing weight, must be checked regularly. The responsible user must define a suitable interval as well as type and scope of this test.
Information is available on KERN's home page (www.kern-sohn.com with regard to the monitoring of balance test substances and the test weights required for this. In KERN's accredited DKD calibration laboratory test weights and balances may be calibrated (return to the national standard) fast and at moderate cost.

4 Basic Safety Precautions

4.1 Pay attention to the instructions in the Operation Manual

Carefully read this operation manual before setup and commissioning, even if you are already familiar with KERN balances.

4.2 Personnel training

The appliance may only be operated and maintained by trained personnel.

5 Transport and storage

5.1 Testing upon acceptance

When receiving the appliance, please check packaging immediately, and the appliance itself when unpacking for possible visible damage.

5.2 Packaging / return transport

- ⇨ Keep all parts of the original packaging for a possibly required return.
- ⇨ Only use original packaging for returning.
- ⇨ Prior to dispatch disconnect all cables and remove loose/mobile parts.
- ⇨ Reattach possibly supplied transport securing devices.
- ⇨ Secure all parts such as the weighing platform, power unit etc. against shifting and damage.

6 Unpacking, Setup and Commissioning

6.1 Installation Site, Location of Use

The balance is designed in a way that reliable weighing results are achieved in common conditions of use.
You will work accurately and fast, if you select the right location for your balance.

On the installation site observe the following:

- Place the balance on a firm, level surface.
- Avoid extreme heat as well as temperature fluctuation caused by installing next to a radiator or in the direct sunlight.
- Protect the balance against direct draughts due to open windows and doors.
- Avoid jarring during weighing.
- Protect the balance against high humidity, vapours and dust.
- Do not expose the device to extreme dampness for longer periods of time. Non-permitted condensation (condensation of air humidity on the appliance) may occur if a cold appliance is taken to a considerably warmer environment. In this case, acclimatize the disconnected appliance for ca. 2 hours at room temperature.
- Avoid static charge of goods to be weighed or weighing container.
- Do not operate in areas with hazard of explosive material or in potentially explosive atmospheres due to materials such as gasses, steams, mists or dusts.
- Keep away chemicals (such as liquids or gasses), which could attack and damage the balance inside or from outside.
- If electro-magnetic fields or static charge occur, or if the power supply is unstable major deviations on the display (incorrect weighing results) are possible. In that case, the location must be changed.

6.2 Unpacking, Scope of delivery

Remove balance and accessories carefully from packaging, remove packaging material and place device at the planned work place. Verify that there has been no damage and that all packing items are present.

Scope of delivery / serial accessories:

- Balance, see chap. 2.0
- Mains adapter
- Flush-mounted hook
- Operating instructions

6.3 Mains connection

Power is supplied via the external mains adapter. The stated voltage value must be the same as the local voltage.
Only use original KERN mains adapters. Using other makes requires consent by KERN.

6.4 Battery operation (optional)

Remove the battery compartment cover on the underside of the scale and connect a 9 V block battery. Replace the battery compartment cover.

For battery operation the balance has an automatic switch-off function which can be activated or deactivated in the menu (chapter 13).

⇨ In the weighing mode, press PRINT and hold longer until [**Pr**] is displayed.

⇨ Press repeatedly until "**AF**" appears.

⇨ Acknowledge with TARE.

⇨ Use now to select between the following two settings:

„AF on“: In order to save the battery, the balance switches automatically off after 3 minutes without weighing.
„AF off“: Switch-off function deactivated.

⇨ Acknowledge selection by TARE. The balance returns to weighing mode.

If the batteries are run down, "**LO**" appears in the display. Press **ON/OFF**-key and replace the batteries immediately.
If the balance is not used for a longer time, take out the batteries and store them separately. Leaking battery liquid could damage the balance.

6.5 Initial Commissioning

A warming up time of 2 hours after switching on stabilizes the measuring values.

The accuracy of the balance depends on the local acceleration of gravity.
Strictly observe hints in chapter “Adjustment”.

6.6 Adjustment

As the acceleration value due to gravity is not the same at every location on earth, each balance must be coordinated - in compliance with the underlying physical weighing principle - to the existing acceleration due to gravity at its place of location (only if the balance has not already been adjusted to the location in the factory). This adjustment process must be carried out for the first commissioning, after each change of location as well as in case of fluctuating environment temperature. To receive accurate measuring values it is also recommended to adjust the balance periodically in weighing operation.

- ☞ Prepare the required adjustment weight.
  The adjustment should be made with the recommended adjustment weight (see chap. 1 "Technical data"). Adjustment is also possible with the weights of other nominal values (see table 13.3), but not the optimum for measuring technique.
- ☞ Observe stable environmental conditions.
- ☞ A warming up time (see chapter 1) is required for stabilization.
- ☞ Ensure that there are no objects on the weighing pan.

Procedure:
EMB 200-3V as an example.

1. Start balance by pressing ON/OFF.

2. Press TARE and hold down longer, the display shows "**CAL**" briefly. Then the display shows the exact size of the adjustment weight (See chapter 13.3).

3. During this display, set the adjustment weight in the middle of the weighing plate

English

4. Press TARE, short time later there appears „**CAL F**“, then the automatic return to the weighing mode. In the display there appears the value of the adjustment weight.

An error during adjustment or the use of an incorrect adjusting weight will result in an error message „**CAL E**“. Repeat adjustment.

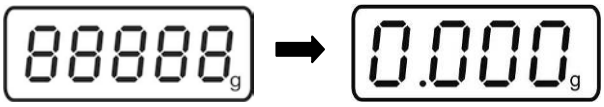
Keep the adjustment close to the balance. Daily control of the weighing exactness is recommended for quality-relevant applications.

7 Basic Operation

EMB 200-3V as an example.

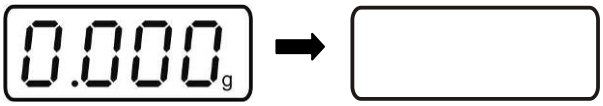
Start-up

⇨ Press the **ON/OFF** key.
The balance will carry out a self-test As soon as the weight display appears, the balance is ready for weighing.



Switching Off

⇨ Press **ON/OFF** button, the display disappears



Weighing

⇨ Place goods to be weighed on balance.

⇨ Wait for stability display [g]

⇨ Read weighing result.

If the weighing object is heavier than the weighing range, the display shows the error message "**E**".

English

Taring

⇨ Place an empty weighing container, the weight of the weighing container will be displayed.

⇨ Press the **TARE** button, the zero display disappears. The tare weight is saved until it is deleted.

⇨ Weigh the material, the net weight will be indicated.

The taring process can be repeated any number of times, e.g. when adding several components for a mixture (adding). The limit is reached when the whole weighing range is exhausted.

After removing the weighing container, the weight of the weighing container appears as negative display.

The tare weight is saved until it is deleted.

Delete tare

⇨ Unload the balance and press the **TARE** button, the zero display appears.

English

8 Density determination

8.1 Principle of Density Determination

Three physical magnitudes are the **volume** and the **mass** of bodies as well as the **density** of matter. In density mass and volume are related.

Density [ρ] is the relation of mass [m] to volume [V].

$$\rho = \frac{m}{V}$$

SI-unit of density is kilogram divided by cubic meter (kg/m³). 1 kg/m³ equals the density of a homogenous body that, for a mass of 1 kg, has the volume of 1 m³. Additional frequently applied units include:

$$1\,\frac{g}{cm^3}, \quad 1\,\frac{kg}{m^3}, \quad 1\,\frac{g}{l}$$

The determination of the density is based on the "**Archimedean Principle**", which states that every object that is dipped into a liquid is as much lighter as the liquid that it displaces.

Thus, density is calculated according to the formulae below:

➢ Density determination of solids

Our balances enable weighing of solids in air [A] as well as water [B]. If the density of the buoyancy medium is known [ρ_o] the density of the solid [ρ] is calculated as follows:

$$\rho = \frac{A}{A-B}\,\rho_o$$

ρ = density of sample
A = weight of the sample in air
B = weight of the sample in the aid liquid
ρ_o = density of the aid liquid

English

➢ Determining density of liquids

The density of a fluid is determined with the help of a sinker providing a known volume [V]. The sinker is weighed in air [A] as well as in the test fluid [B]. According to the Archimedes' Principle a body immersed in a fluid experiences a force of buoyancy. [G]. This force equals the weight force of the fluid displaced by the volume of the body.
The volume [V] of the immersed body equals the volume of the displaced fluid.

$$\rho = \frac{G}{V}$$

G = buoyancy of sinker

Buoyancy of sinker =
Weight of the sinker in air [A] - weight sinker in test liquid [B]

From this follows:

$$\rho = \frac{A-B}{V}$$

ρ = density of test liquid
A = weight of sinker in air
B = weight of the sinkers in test liquid
V = volume of sinker*

8.1.1 Influencing magnitudes and error sources

- ⇨ Air pressure
- ⇨ Temperature
- ⇨ Volume deviation of the sinker
- ⇨ Surface tension of the liquid
- ⇨ Air bubbles
- ⇨ Immersion depth of the sample dish of sinker
- ⇨ Porosity of the solid

8.2 Density determination of solids

For the determination of the density of solids, the solid is first weighed in air and then in the aid liquid, whose density is known. From the weight difference results the buoyancy from where the software calculates the density.
As aid liquid, usually distilled water or ethanol is used, see density table chapter 10.

8.2.1 Density determination while using the density kits KERN YDB-01 or YDB-02

For the density determination, we recommend to work with the optional density kit KERN YDB-01 or YDB-02. This contains all the necessary structures and resources for a comfortable and precise determination of the density.

- If needed, perform necessary adjustment prior to the installation of the density kit, see chapter 6.6.
- When the density kit is installed, correct adjustment is not possible.
- For reasons of adjustment, take away the density kit and place the standard weighing plate.

Fig.: Installed density kit KERN YDB-01

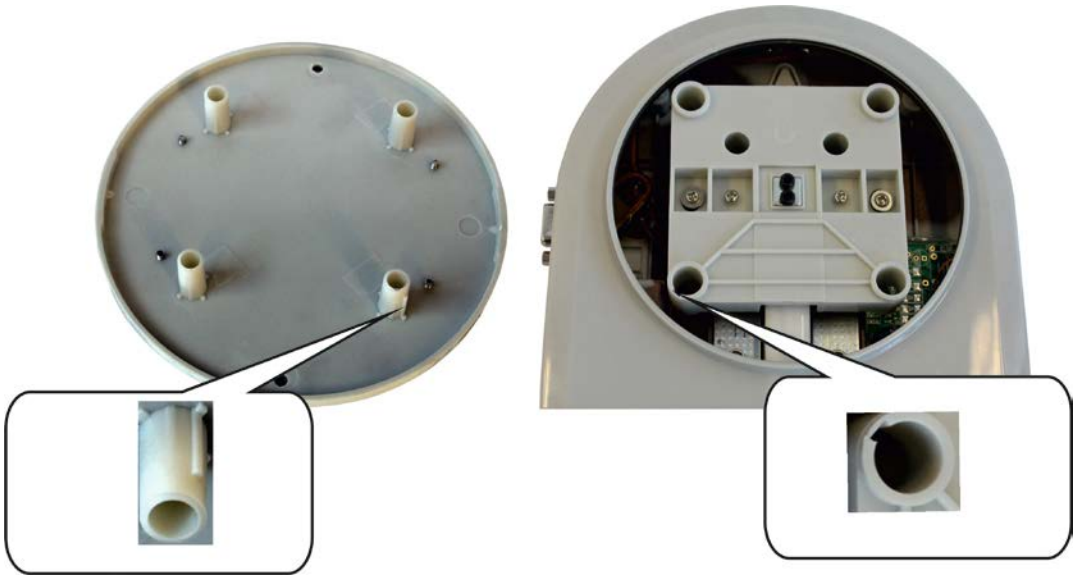
Abb.: Installed density kit KERN YDB-02

Install the density kit

⇨ Disconnect scale from power supply.

⇨ Remove the standard weighing plate and replace it with the density kit.

⚠ **Model EMB 2000-2V**
Ensuring correct positioning, see illustration below.



⇨ Place the platform for glass containers in a way that it does not touch the weighing plate.

⇨ Place beaker in the centre of the platform Make sure that it has no contact with the frame.

⇨ Hang the immersion basket on the rack. Make sure that it is centred in the recess.

⇨ Pour the liquid into the glass beaker. Filling height should be approx. ¾ of the capacity. Immerse thermometer

⇨ Heat the liquid, the instruments or the displacement body until the temperature is constant. Observe the warm-up time of the balance.

For more information, please refer to the operating manual supplied with the density kit.

English

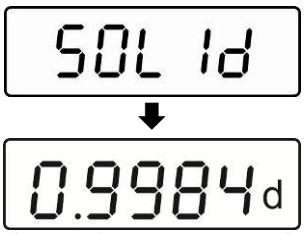
Procedure

☞ **Access mode for the density determination of solids.**

5. Turn on the scale with ON/OFF, "0.000" is displayed.

6. If the scale does not display "0.000", press TARE

7. Access by pressing density determination mode for solids.



(example water at 19°C)

"SOLId" is briefly displayed, followed by the actual entered density of the aid liquid. If necessary, change as described later.

☞ **Enter the density of the aid liquid while taking into account the current temperature (See density table chapter 10).**

8. Press REF and the last digit flashes.

9. Use ↑ to increase the numeric value of the flashing cipher.

   Use REF to move the number selection to the right, the respective active position flashes.

10. Confirm input by PRINT.

(example water at 23°C)

☞ **Density determination solids**

11. Lay the solid in the upper sample dish.
12. Press and the weight of the sample in air is shown.

(example)

13. Lay the sample into the lower sample dish and immerse it in the aid liquid. Make sure that the sample is at least 1 cm immersed and has, if possible, no air bubbles adhering to it.
14. Press and for a short time the weight of the sample in the aid liquid is displayed.

(example)

The scale determines the density of the solid and subsequently displays the result.

(example)

When connecting an optional printer, press

to print the result.

Printout example KERN YKB-01N:

D-REF:	0.9976 g/cm^3	Density aid liquid
D-RSL:	8.0409 g/cm^3	Result (density of the sample)
W-AIR:	020.000 g	Weight of the sample in air
W-LDQ:	017.432 g	Weight of the sample in liquid

Press

; balance will return to weighing mode. For further measurements start at step 2.

English

8.2.2 Density determination using the suspended weighing device

Density determination with help of the suspended weighing device is recommended for samples that do not fit, due to size or shape, in the sample dish or glass beaker of the optional density kits.
In this method, the solid is first weighed in air.
Afterwards, the solid is immersed in the aid liquid (at the right temperature), so that it doesn't touch the bottom of the glass beaker, but is still completely submerged. Now it is weighed again. From the two weight values, the scale determines the density of the solid and displays it.

How to prepare the weighing balance

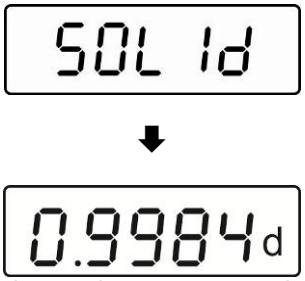
- ⇨ Turn off the scale and turn it around.
- ⇨ Open closing cover at the balance bottom.
- ⇨ Mount the hooks for underfloor weighing.
- ⇨ Place weighing balance over an opening.
- ⇨ Attach the suspension device.
- ⇨ Fill the aid liquid into a glass beaker.
- ⇨ Heat the liquid, the instruments or the sinker until the temperature is constant. Observe the warm-up time of the balance.

Calculate density

☞ **Access mode for the density determination of solids.**

⇨ Start balance by pressing ON/OFF If the scale does not display zero, tare with TARE

⇨ Access by pressing density determination mode for solids.



(example water at 19°C)

"SOLId" is briefly displayed, followed by the actual entered density of the aid liquid.

☞ **Enter the density of the aid liquid while taking into account the current temperature (See density table chapter 10).**

⇨ Press REF and the last digit flashes.

⇨ Use ↑ to increase the numeric value of the flashing cipher.

Use REF to move the number selection to the right, the respective active position flashes.

⇨ Confirm input by PRINT.

(example water at 23°C)

☞ **Density determination “solids“**

⇨ Hang the sample on the suspension device.

⇨ Press and the weight of the sample in air is shown.

(example)

⇨ If possible, immersed the sample bubble free in the aid liquid. Make sure that the sample is at least 1 cm immersed and doesn't touch the glass beaker.

⇨ Press and for a short time the weight of the sample in the aid liquid is displayed.

(example)

⇨ The scale determines the density of the solid.
Wait until the result is displayed.

(example)

When connecting an optional printer, press

to print the result, see printout example chapter 8.2.1.

Using

the balance returns into the weighing mode.

8.2.3 Density determination of solid material with a density of less than 1 g/cm^3

At solid material with density less than 1 g/cm^3 , a density determination with two different methods is possible.

Method 1:

As aid liquid is used a liquid with less density than that of the solid material, e.g. ethanol approx. 0.8 g/cm^3.
This method should be applied when the density of the solid is just slightly different from that of the distilled water.
Using ethanol is not recommended, when the solid material is being attacked.

When working with ethanol, you must observe the applicable safety regulations.

Method 2:

Here the sample is not placed upon, but **under** the sample dish. Here, the immersion basket for floating solids is to be used.

Fig.: Density kit KERN YDB-01 with installed immersion basket for floating solid matter.

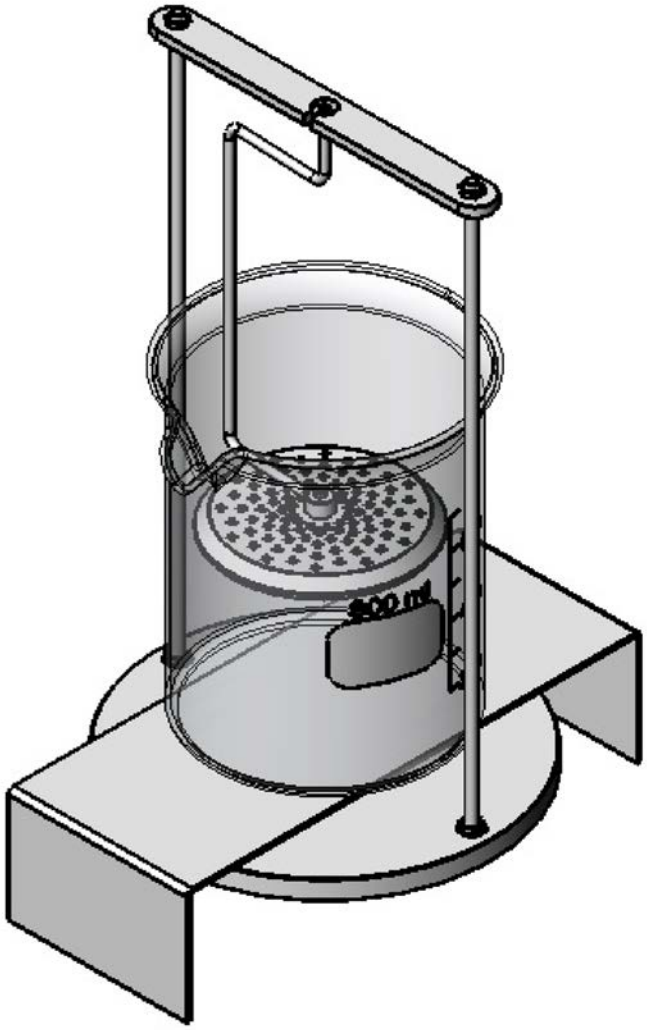


Abb.: Density kit KERN YDB-02 with installed immersion basket for floating solid matter.

⇨ Activate function, see chap. 8.2.1.

⇨ Input parameter for aid liquid, see chapter 8.2.1.

⇨ Density determinations, see chapter 8.2.1, in step 9 enter the sample under the lower sample dish. If the buoyancy of the sample is so much that the immersion basket is lifted, place a dummy weight on it and tare it away when weighing in air.

8.3 Determining density of liquids

At the density determination of liquids, a sinker is used whose density is known. The sinker is weighed first in air and then in the liquid whose density is to be determined. From the weight difference results the buoyancy from where the software calculates the density.

The density of the enclosed steel sinker can be determined as described in chapter, 8.2.1.
Or quickly and inexpensively in our calibration laboratory.
For further information please go to KERN- Hompage (www.kern-sohn.com).

8.3.1 Density determination while using the density kits KERN YDB-01 or YDB-02.

☞ **Install the density kit, see chapter 8.2.1**

☞ **Mode to call up density determination of liquids.**

1. Turn on the scale with ON/OFF, "0.000" is displayed.

2. If the scale does not display, "0.000", press TARE

3. Call up the density determination mode of liquids by pressing .

"Liquid" is displayed briefly, followed by the actual entered density of the sinker. Initial entry or if it is necessary to change them describes will be described later.

While using the same sinker, the entered density stays stored. Skip the following steps for additional measurements and start by determining the density of the liquid (step 7).

English

☞ **Enter the density of the sinker.**

4. Press REF and the last digit flashes.

5. Use ↑ to increase the numeric value of the flashing cipher.
   Use REF to move the number selection to the right, the respective active position flashes.
6. Confirm input by PRINT.

☞ **Density determination liquids**

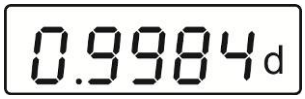
7. Place sinker in the upper sample dish.
8. Press ⚖ and the weight of the sinker in air is displayed.

(example)

9. Lay the sinker in the lower sample dish and immerse it into the test liquid. Make sure that the sinker is at least 1 cm submerged and that, if possible, no air bubbles adhere to it.
10. Press ⚖ and for a short time the weight of the sinker in the test liquid is displayed.

(example)

The scale determines the density of the liquid and then displays the result.



(example)

When connecting an optional printer, pressing of

will print the result.

Printout example KERN YKB-01N:

D-REF:	8.0409 g/cm^3	Sinker density
D-RSL:	0.9984 g/cm^3	Result (Density of the test liquid)
W-AIR:	020.000 g	Weight of sinker in air
W-LDQ:	017.432 g	Weight of the sinker in liquid

Press

; balance will return to weighing mode. For further measurements start at step 2.

English

8.3.2 Density determination using the suspended weighing device

How to prepare the weighing balance

- ⇨ Turn off the scale and turn it around.
- ⇨ Open closing cover at the balance bottom.
- ⇨ Mount the hooks for underfloor weighing.
- ⇨ Place weighing balance over an opening.
- ⇨ Attach the suspension device.
- ⇨ Pour the test liquid into a glass beaker.
- ⇨ Control the temperature of the liquid, instruments and the displacement body until the temperature is constant. Observe the warm-up time of the balance.

☞ **Mode to call up density determination of liquids.**

1. Turn on the scale with ON/OFF, "0.000" is displayed.

2. If the scale does not display, "0.000", press TARE

3. Call up the density determination mode of liquids by pressing .

"Liquid" is displayed briefly, followed by the actual entered density of the sinker. Initial entry or if it is necessary to change them describes will be described later.

While using the same sinker, the entered density stays stored. Skip the following steps for additional measurements and start by determining the density of the liquid (step 7).

☞ **Enter the density of the sinker.**

4. Press REF and the last digit flashes.

5. Use ↑ to increase the numeric value of the flashing cipher.

   Use REF to move the number selection to the right, the respective active position flashes.

6. Confirm input by PRINT.

☞ **Density determination “liquids“**

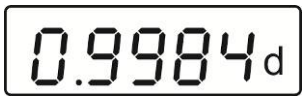
7. Hang the sinker on the suspension device.
8. Press and the weight of the sinker in air is displayed.

(example)

9. If possible, immerse the sinker bubble free in the aid liquid. Make sure that the sinker is at least 1 cm submerged and doesn't touch the glass beaker.
10. Press and for a short time the weight of the sinker is displayed in the aid liquid.

(example)

The scale determines the density of the liquid and then displays the result.



(example)

When connecting an optional printer, pressing of PRINT will print the result, see printout example chapter 8.3.1.

Press ESC, the balance will return to weighing mode. For further measurements start at step 2.

English

9 Preconditions for Precise Measurements

There are numerous error possibilities during density determination.
Accurate knowledge and caution are required to achieve precise results when applying this density kit in combination with the balance.

9.1 Calculation of Results

The balance displays results for density determination by giving four decimal places. However, this does not mean that the results are accurate down to the last decimal place as this would be the case for a calculated value. Therefore all weighing results used for calculations have to be examined closely.
Example for density determination of solids:
To ensure high-grade results, numerators as well as common denominators of the formula below must show the desired accuracy. If either of them is instable or flawed, the result, too, will be instable or flawed.

$$\rho = \frac{A}{A\text{-}B}\,\rho_o$$

ρ = density of sample
A = weight of the sample in air
B = Weight of the sample in the aid liquid
ρ_o = Density of the aid liquid

9.2 Influence Factors for Measurement Errors

9.2.1 Air bubbles

A small bubble with a diameter of 1 mm results in a raise of 0.5 mg, while those with 2 mm Ø already produce a raise of 4 mg.
Therefore, make sure that no air bubbles adhere on the fixed object or sinker that is immersed in the liquid.
An oily surface causes air bubbles when immersing in the liquid, so

- degrease the solvent-resistant solid sample
- clean all parts that are immersed regularly and don't touch them with bare fingers

Don't lay solid samples (particularly flat objects) outside of the liquid on the sample dish, because this results in air bubbles by the joint immersion.

9.2.2 Solid body sample

A sample possessing too great a volume that is immersed in fluid will result in an increase in fluid level inside the glass pitcher. As a result, part of the suspension bracket of the sifting bowl will also be immersed causing buoyancy to increase. As a consequence the weight of the specimen in the fluid will drop.
Samples that change the volume or assimilate fluid are unsuitable for measurement.

9.2.3 Liquids

Solids are generally not sensitive to temperature changes, so that the corresponding density changes are not relevant. However, since you work with an aid liquid by the density determination of solids, according to the "Archimedean Principle", its temperature is taken into account. The temperature change effects liquids greater and causes changes in the density in order of 0.1 to 1 ‰ per °C. Hereby, the third digit after the decimal point is affected.

9.2.4 Surface

The suspension bracket of the sample dish penetrates the surface of the fluid. This state undergoes continuous change. If the sample or the sinker is relatively small, the surface tension will impair repeatability. The addition of a small amount of detergent makes the surface tension negligible and increases repeatability.

9.2.5 Sinker for density determination of liquids.

To save test fluids by the density determination of liquids, a small glass beaker and an appropriate sinker is to be used. Hereto, it should be noted that a larger sinker achieves greater accuracy.
Determine the buoyancy and volume of the sinker as accurately as possible. For the determination of fluid density these results are applied to the common denominator as well as the numerator of the formula.

9.3 General information

9.3.1 Density / Relative Density

Relative density follows from the weight of a specimen divided by the weight of water (at 4° Celsius) of the same volume. For this reason relative density does not have a unit. Density equals mass divided by volume.
The application of the relative density instead of the density of a fluid in a formula produces an incorrect result. In the case of fluids only their density is physically meaningful.

9.3.2 Drift of Balance Display

The drifting of a balance does not influence the final result of the density determination although the shown weight of weighing in air is affected. Accurate values are merely required if the density of fluids is determined by means of a sinker. When changing the ambient temperature or location, an adjustment of the balance is necessary. Hereto, remove the density kit and carry out an adjustment with the standard weighing plate (See chapter 6.6).

10 Density Table for Fluids

Temperature [°C]	Density ρ [g/cm^3]		
	Water	Ethyl alcohol	Methyl alcohol
10	0.9997	0.7978	0.8009
11	0.9996	0.7969	0.8000
12	0.9995	0.7961	0.7991
13	0.9994	0.7953	0.7982
14	0.9993	0.7944	0.7972
15	0.9991	0.7935	0.7963
16	0.9990	0.7927	0.7954
17	0.9988	0.7918	0.7945
18	0.9986	0.7909	0.7935
19	0.9984	0.7901	0.7926
20	0.9982	0.7893	0.7917
21	0.9980	0.7884	0.7907
22	0.9978	0.7876	0.7898
23	0.9976	0.7867	0.7880
24	0.9973	0.7859	0.7870
25	0.9971	0.7851	0.7870
26	0.9968	0.7842	0.7861
27	0.9965	0.7833	0.7852
28	0.9963	0.7824	0.7842
29	0.9960	0.7816	0.7833
30	0.9957	0.7808	0.7824
31	0.9954	0.7800	0.7814
32	0.9951	0.7791	0.7805
33	0.9947	0.7783	0.7896
34	0.9944	0.7774	0.7886
35	0.9941	0.7766	0.7877

11 Uncertainty of Measurement for Density Determination of Solids

This table shows the approximate readability of the balance in connection with the density kit. Observe that these values have only been determined by calculation and that influent parameters such as described in chapter 6 have not been taken into consideration.

Approximate display at density measurements (when using a balance with a readability of 0.01g*)									
Weight of sample (g) / Density of sample [g/cm^3]	1	10	50	100	500	1000	2000	3000	4000
1	0.1	0.01	0.003	0.002	0.0005	0.0003	0.0003	0.0002	0.0002
3	0.4	0.04	0.01	0.005	0.001	0.001	0.0005	0.0004	0.0004
5	0.7	0.07	0.01	0.008	0.002	0.001	0.001	0.001	0.0006
8	1.2	0.1	0.02	0.01	0.003	0.002	0.001	0.001	0.001
10	1.5	0.1	0.03	0.02	0.004	0.002	0.001	0.001	0.001
12	1.7	0.2	0.04	0.02	0.004	0.002	0.002	0.001	0.001
20	2.9	0.3	0.06	0.03	0.01	0.004	0.003	0.002	0.002

*when using a balance with a readability of 0.1 g, the numbers in this table have to be multiplied with 10. When using a balance with a readability of 0.001 g, divide the numbers through 10.

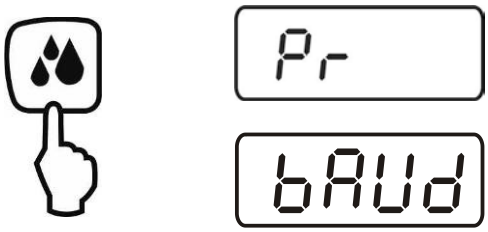
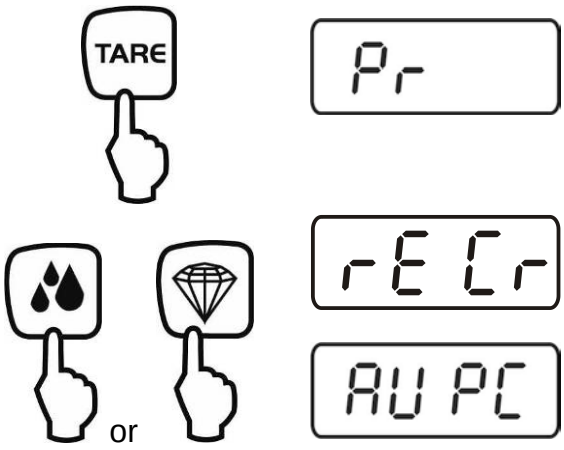
Reading example for table:
In a balance with a resolution of 0.001 g and a sample with a weight of 10 g, whose density is 5 g/cm^3, the display graduation is at 0.007 g/cm^3.

12 User Instructions

- To form a reproducible mean value several density measurement are necessary
- Remove fat from solvent-resistant sample / sinker /beaker.
- Regularly clean sample dishes/ sinker/beaker, do not touch immersed part with your hands
- Dry sample/ sinker/pincers after each measurement.
- Adjust sample size to sample dish (ideal sample size > 5 g).
- Only use distilled water.
- When immersing for the first time, lightly shake sample dishes and sinker, in order to Dissolve air bubbles.
- Always ensure that, when re-immersing into the liquid no additional bubbles adhere; it is better to use pincers to place the sample.
- Remove firmly adherent air bubbles with a fine brush or a similar tool.
- To avoid adherent air bubbles smoothen samples with rough surface.
- Take care that no water drips onto the upper sample dish when weighing with the help of tweezers.
- In order to reduce the surface tension of water and the friction of the liquid on the wire, add three drops of a common detergent (washing-up liquid) to the aid liquid (density modification of dest. water occurring due to the addition of tensides can be ignored).
- Oval samples can be held more easily with pincers when you cut grooves into them.
- The density of porous solids may only be determined approximately. Buoyancy errors occur when not all the air is eliminated from the pores during immersion in the aid fluid.
- To avoid great vibrations of the balance, place sample carefully.
- Avoid static charge, e. g. dry sinker with cotton cloth only.
- If the density of your solid only deviates slightly from that of distilled water, ethanol may be used as aid liquid. However, check beforehand whether the sample is solvent-proof. In addition you must observe the applicable safety regulations when working with ethanol.
- To avoid corrosion, don't leave the density kit immersed in liquid for a long time.

13 Menu

13.1 Navigation in the menu

Access to menu 	In weighing mode keep the **PRINT** key pressed until **[Pr]** appears.
How to select menu items 	With help of , the individual menu items can be selected one after the other. Use to scroll forward Use to scroll backward
Change settings 	Acknowledge selected menu item using **TARE** key, the current setting is displayed. Use to scroll forward Use to scroll backward Each time you press the button, the next setting is displayed, see chapter 13.2 "Menu- Overview".
How to save settings and to exit the menu 	⇨ Press the **TARE** key; balance will return to weighing mode.

English

13.2 Menu overview

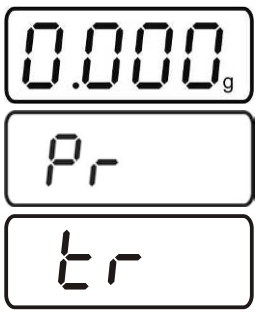
Description of function	Function	Parameters	Description of options	
Data transfer mode (see chapter 13.4)	**PR**	**rE CR***	Data output via remote control commands (see chapter 14)	
			Data output by pressing the PRINT key (see chapter 14)	
		AU PC	Continuous data output (see chapter 14)	
Baud rate (see chapter 13.4).	**bAUd**	**19200**		
		9600*		
		4800		
		2400		
		1200		
Auto off (battery operation), see chap. 6.4	**AF**	**on***	Automatic switch-off function after 3 min without changing load ON	
		off	Automatic switch-off function after 3 min without changing load OFF	
Auto Zero (see chapter 13.3)	**tr**	**on***	On	
		off	Off	
Select the adjustment weight	**CAL**	**50.000**		
		100.000		
		150.000		
		200.000*		
Filter (See chapter 13.3) For adapting to the ambient conditions.	**FiltEr**	**Slo***	slow	slow / insensible ↕ fast/sensitive
		Hr.	standard	
		FSt	fast	
Reset to factory setting (see chap. 13.3)	**rSt**	**no***	no	
		yes	yes	

* = default setting

13.3 Description of individual menu items

Dosing and Zero-tracking

The Auto-Zero function is used to tare small variations in weight automatically.
In the event that small quantities are removed or added to the material to be weighed, incorrect weighing results can be displayed due to the “stability compensation“. (Example: Slowly draining fluids from a container on the balance).
When apportioning involves small variations of weight, it is advisable to switch off this function.
If **Zero-Tracking** however is switched off, the weighing display becomes more busy.



☐ Keep PRINT pressed in the weighing mode until [**Pr**] is displayed.

☐ Press repeatedly until "tr" is displayed.

☐ Acknowledge using TARE, the current setting is displayed.

☐ Select desired settings by .

tr	**on**	Function activated
tr	**off**	Function deactivated

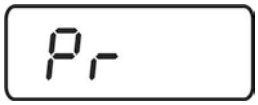
☐ Acknowledge selection by TARE.

English

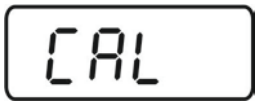
Selection adjustment weight

The adjustment weight can be selected out of four (CAL1 / Cal 2) predetermined nominal values (ca. 1/4; 1/2; 3/4; Max). In order to achieve high-quality weighing results in the sense of the measuring technology, it is recommended to select the nominal value as high as possible

⇨ Keep PRINT pressed in the weighing mode until [**Pr**] is displayed.



⇨ Press repeatedly until „CAL“ will be displayed.



⇨ Acknowledge using TARE, the current setting is displayed.

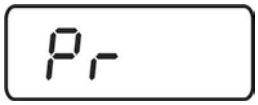
⇨ Select desired setting by .

⇨ Acknowledge selection by TARE.

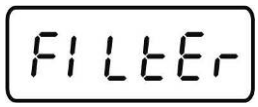
Filter

With the filter settings, the scale can be tailored to the needs of the specific applications or environmental conditions.

⇨ Keep PRINT pressed in the weighing mode until [**Pr**] is displayed.



⇨ Press repeatedly until "FiltEr" is displayed.



⇨ Acknowledge using TARE, the current setting is displayed.

⇨ Select desired setting by .

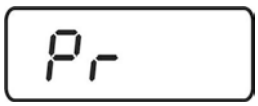
Slo*	slow / insensible
Hr.	↕
FSt	fast/sensitive

⇨ Acknowledge selection by TARE.

Reset to factory setting

This function resets all balance settings to factory setting.

⇨ Keep PRINT pressed in the weighing mode until [**Pr**] is displayed.



⇨ Press repeatedly until "**rSt**" is displayed.

⇨ Acknowledge using TARE, the current setting is displayed.

⇨ Select desired setting by .

rSt	**yes**	Balance will be reset to factory setting.
rSt	**no**	The balance keeps its individual setting

⇨ Acknowledge selection by TARE. The balance returns to weighing mode.

English

13.4 Interface parameters

Data transfer mode

⇨ Keep PRINT pressed in the weighing mode until [**Pr**] is displayed.

⇨ Acknowledge using TARE, the current setting is displayed.

⇨ Select desired setting by .

rE CR	Data output via remote control commands
	Data output using the **PRINT** key
AU PC	Continuous data output

⇨ Acknowledge selection by TARE. The balance returns to weighing mode.

Baud rate

The baud rate defines the transfer speed vie the interface, 1 Baud = 1 Bit/second.

⇨ Keep pressed PRINT in the weighing mode until [**Pr**] is displayed.

⇨ Press repeatedly until "bAUd" is displayed.

⇨ Acknowledge using TARE, the current setting is displayed.

⇨ Use to select the desired settings

9600 ⇨ 4800 ⇨ 2400 ⇨ 1200 ⇨ 19200

⇨ Acknowledge selection by TARE. The balance returns to weighing mode.

14 Data output RS 232 C

Data output is carried out via interface RS 232 C.

The following conditions must be met to provide successful communication between the weighing balance and the printer.

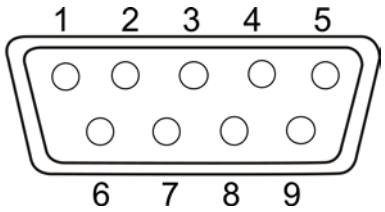
- Use a suitable cable to connect the weighing balance to the interface of the printer/PC.
  Faultless operation requires an adequate KERN interface cable (optional).
- Communication parameters (e.g. baud rate) of the scale and printer must match.

1. Technical data

- 8-bit ASCII Code
- 1 start bit, 8 data bits, 1 stop bit, no parity bit
- Baud rate selectable at 1200, 2400, 4800, 9600 and 19200 Baud
- Miniature plug-in necessary (9 pole D-Sub)

2. Pin allocation of balance output bushing:

Front view:



Pin 2: Transmit data
Pin 3: Receive data
Pin 5: Signal ground

English

3. Explanation of the data transfer

rE Cr:

➢ **PRINT** key

Press the **PRINT** key, at stable weight is transferred.

➢ **Remote control commands**

The remote control commands s/w/t are sent from the remote control unit to the balance as ASCII code. After the balance having received the s/w/t commands, it will send the following data.
Take into account that the following remote control commands must be sent without a subsequent CR LF.

s Function: Stable weighing value for the weight is sent via the RS232 interface

w Function: Weighing value for the weight (stable or unstable) is sent via the RS232 interface

t Function: No data are sent, the balance carries out the tare function.

a. Format for stable values

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
M	S	N_1	N_2	N_3	N_4	N_5	N_6	N_7	N_8	N_9	N_{10}	B	U_1	U_2	U_3	CR	LF

b. Format in case of fault

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
B	B	B	B	B	B	B	B	B	B	B	E	r	r	o	r	CR	LF

c. Format for unstable values

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
M	S	N_1	N_2	N_3	N_4	N_5	N_6	N_7	N_8	N_9	N_{10}	B	B	B	B	CR	LF

AU PC:

The weighing values are sent automatically and continuously, no matter if the value is stable or unstable.

d. Format for stable values

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
M	S	N_1	N_2	N_3	N_4	N_5	N_6	N_7	N_8	N_9	N_{10}	B	U_1	U_2	U_3	CR	LF

e. Format in case of fault

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
B	B	B	B	B	B	B	B	B	B	B	E	r	r	o	r	CR	LF

f. Format for unstable values

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
M	S	N_1	N_2	N_3	N_4	N_5	N_6	N_7	N_8	N_9	N_{10}	B	B	B	B	CR	LF

Symbols

M	Blank or M
S	Space character or negative sign (-)
N_1 … N_{10}	10 numeric ASCII codes for weight values including decimal places or blanks
U_1 … U_3	3 ASCII codes for weighing unit pcs. / % / or blank
B	Space
E, o, r	ASCII code or “E, o, r”
CR	Carriage Return
LF	(Line Feed)

15 Service, maintenance, disposal

Before any maintenance, cleaning and repair work disconnect the appliance from the operating voltage.

15.1 Clean

Please do not use aggressive cleaning agents (solvents or similar agents), but a cloth dampened with mild soap suds. Take care that the device is not penetrated by fluids and polish it with a dry soft cloth.
Loose residue sample/powder can be removed carefully with a brush or manual vacuum cleaner.

Spilled weighing goods must be removed immediately.

15.2 Service, maintenance

- ⇨ The appliance may only be opened by trained service technicians who are authorized by KERN.
- ⇨ Ensure that the balance is regularly calibrated, see chap. Testing instruments control.

15.3 Disposal

- ⇨ Disposal of packaging and appliance must be carried out by operator according to valid national or regional law of the location where the appliance

16 Instant help

In case of an error in the program process, briefly turn off the balance and disconnect from power supply. The weighing process must then be restarted from the beginning.

Help:

Fault	Possible cause
The displayed weight does not glow.	• The balance is not switched on. • The mains supply connection has been interrupted (mains cable not plugged in/faulty). • Power supply interrupted. • Battery is inserted incorrectly or is empty. • No batteries inserted.
The displayed weight is permanently changing	• Draught/air movement • Table/floor vibrations • The weighing plate is in contact with foreign matter. • Electromagnetic fields / static charging (choose different location/switch off interfering device if possible)
The weighing value is obviously wrong	• The display of the balance is not at zero • Adjustment is no longer correct. • The balance is on an uneven surface. • Great fluctuations in temperature. • Electromagnetic fields / static charging (choose different location/switch off interfering device if possible)

Should other error messages occur, switch balance off and then on again. If the error message remains inform manufacturer.